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Introduction to the Symposium: '*Oceans Past V*'

Introduction

Multidisciplinary perspectives on the history of human interactions with life in the ocean

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There is an essentially circular interaction between the human social system and the marine ecosystem. The Oceans Past V Conference "Multidisciplinary perspectives on the history of human interactions with life in the ocean" held in Tallinn, Estonia, in May 2015 was an opportunity for the presentation and discussion of papers on a diverse array of topics that examined this socio-ecological system from a historical perspective. Here we provide background to the disciplines participating in the conference and to the conference itself. We summarize the conference papers that appear in this special volume of the ICES JMS and highlight issues which arose during general discussion. We make two conclusions. First, to have greater impact and ensure more efficient use of knowledge gained from marine historical ecology (MHE) and marine environmental history (MEH) in ecosystem-based management and related policy development, practitioners need to work more routinely with population and ecological modellers and statisticians. This will allow greater processing of the available historical data to derive ecologically meaningful properties that can then be used to assess the ecological impact of long-term changes of affected species and define appropriate and realistic management targets. Second, increased multi- and trans-disciplinary effort is required to better understand the relative importance of different human demographic, technological, economic, and cultural drivers on the patterns, intensities and trajectories of human activities affecting marine ecosystems.

Keywords: marine environmental history, marine historical ecology, oceans past, socio-ecological system.

Introduction

Understanding, quantifying, and predicting human impacts on the world's oceans requires examination of the patterns, intensities, and trajectories of these activities over a very long period of time. In order for human society to respond appropriately to its impacts, research findings must be translated into marine policy development and inform management action. Human activities not only affect marine populations and ecosystems but also shape the coastal communities that make a living from the sea through changes in the goods and services these can provide. This essentially circular interaction between the human social system and the marine ecosystem has been summarized by Schwerdtner-Máñez *et al.* (2014) (see Figure 1, updated). The Oceans Past V Conference "Multidisciplinary perspectives on the history of human interactions with life in the ocean" held in Tallinn, Estonia, in May 2015 was an opportunity for the presentation and discussion of over 55 oral and poster papers on a diverse array of topics that examined this socio-ecological system from a historical perspective (the conference programme and paper abstracts are available as Supplementary S1 and S2). Over the last 20 years what is knowable and acceptable as information that can usefully compliment modern quantitative fisheries catch information, research survey data, and ecological studies has expanded globally as the new disciplines of marine historical ecology (MHE) and marine environmental history (MEH) have emerged (Holm *et al.*, 2001, 2010; Bolster, 2006; Poulsen, 2010; Lotze and McClenachan, 2013). These new disciplines, the former from an ecological perspective and the latter from a human centred perspective, help to bridge the gap between the modern statistical era, when information about marine resource use and state is routinely collected

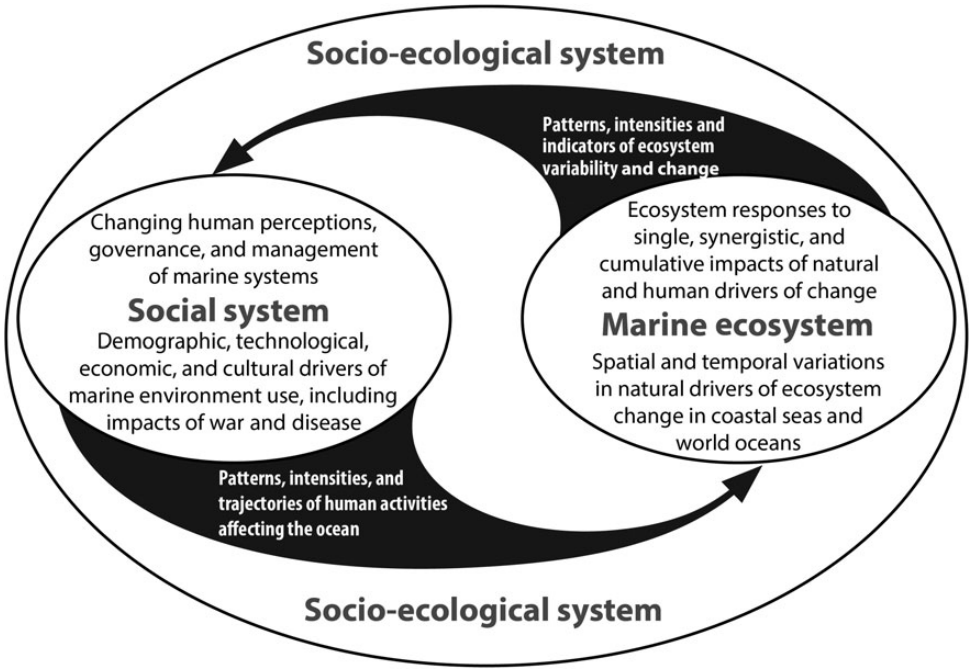

Figure 1. The marine socio-ecological system (adapted from Schwerdtner-Máñez *et al.*, 2014).

in a deliberate and organized manner, and previous periods for which palaeontological, archaeological, and historical sources are only available (Holm *et al.*, 2010; Poulsen, 2010).

Themes, papers, and presentations

Organized by the international Oceans Past Initiative—a global research network for marine historical research—and co-sponsored by the International Council for the Exploration of the Sea, and the EU COST Action on Oceans Past Platform, the symposium (i) examined the historical trajectory and impacts of several human activities (fishing, eutrophication, aquaculture, and bio-invasions), and climate variability and change on both exploited and non-target species, foodwebs, and habitats; (ii) explored some implications of historical marine ecology and marine history for marine policy development; and (iii) considered how coastal communities are shaped mainly by human induced environmental change and the social drivers of resource use. Most presentations addressed case studies in the Northeast Atlantic, Mediterranean Sea, and northwest Atlantic, although some presentations addressed cases in the southwest Pacific and Indian Ocean. A feature of most presentations was their dependence mainly on written records of catches, distributions, sizes, and fishing regulations; relatively few studies were based on archaeological finds, paleo-oceanographic data, or stable isotopes although these sources have much to offer historical studies. The six papers from the conference that appear in this issue of the ICES JMS exemplify the three major themes outlined above.

The first theme of historical trajectories of human activities in the ocean is investigated by Jones *et al.* (2016) who combines the anecdotal evidence of fishers to parliamentary commissions of inquiry with historical data relating to landings and fishing effort to calculate catch per unit effort in Scotland's regional fisheries in the 19th century. To their surprise, they found that in some areas inshore stocks of commercial whitefish appear to have been in decline by the mid-1850s, probably due to the rapid intensification of fishing from open boats using the traditional techniques of handlines and longlines, many years before the widespread adoption of beam trawling in Scotland. McCain *et al.* (2016) go one step further—not only do they use historical beach-seine datasets to document changes in the abundance of juvenile cod (*Gadus morhua*) in 42 bays along the east coast of Newfoundland before (1959–1964) and after (1992–1996) the collapse of the Northwest Atlantic cod stocks in the early 1990s, but they also used the rich data sources to explore the impact of the cod collapse on the wider inshore fish community. They found that, while total fish abundance declined significantly with the decrease of cod, Shannon diversity and species evenness significantly increased, indicating a clear-cut reorganization of coastal fish communities after a large-scale fisheries collapse with implications for inshore–offshore ecosystem connectivity.

The utility of historical marine ecological research in marine policy and planning were evident in research undertaken by Alleway *et al.* (2016) who reviewed historical fisheries records on the now extinct fishery for the native oyster *Ostrea angasi* in South Australia and identified introductions of the non-native Sydney rock oyster, *Saccostrea glomerata*, from 1866 through 1959. As a result, new areas for oyster aquaculture were included in regulatory zoning (spatial planning) in the State, there is now increasing commercial interest in growing *O. angasi*, the biosecurity risk of aquaculture for *S. glomerata* was evaluated, and applications to culture this species are likely to be deemed acceptable. Marine policy implications of MHE or its potential to inform management were also explored by Engelhard *et al.* (2016) in 13 case studies from around the world. Considerations of the background problem, the contribution of MHE, and the policy relevance indicated how MHE has and can contribute to addressing six current marine policy issues: climate change, biodiversity conservation, ecosystem structure, habitat integrity, food security, and governance. To ensure the continuing relevance of MHE the authors encourage "... a future where MHE scientists will increasingly 'think policy', so that their work might more readily make a difference, and where policy-makers

will increasingly 'think MHE' in support of long-term marine conservation and sustainable resource use."

The third theme of how coastal communities are shaped by human induced environmental change and the social drivers of resource use is explored by Tull *et al.* (2016) in the examination of past and projected change in the coastal town of Geraldton in Western Australia. In this study, changes in Geraldton's socio-ecological vulnerability over time are calculated by integrating adaptive capacity with environmental change (principally sea temperature rise and increased storminess), resource dependence, and the socio-economic importance of fished species (spiny lobster and finfish) during four census years: 1921, 1954, 1981, and 2011. With progressively greater exposure to climate change over the period, and the high socio-economic importance of fished species, as well as relatively poor physical, social, and natural capital, Geraldton's socio-ecological vulnerability has increased over the last 90 years while its adaptive capacities have decreased. Without proactive intervention, these trends are likely to intensify.

Canadelli (2016) explores a different aspect of human interaction with the sea—the establishment of a marine research laboratory on the Venetian lagoon at Chioggia, Italy, in 1940 within the historical context of the founding of other similar laboratories worldwide and their importance as a focus for research on aquatic organisms. The author explores a tension at many laboratories between researchers interested in basic biological, evolutionary, and ecological research and those, including managers and funders, who placed priority on the practical and economic applications of research for fisheries and aquaculture. Canadelli concludes that "D'Ancona succeeded where many zoologists failed, placing his 'little laboratory' at the disposition of an international network of marine scientists and conducting research that was of benefit not only to scholarship, but also to the local fishing community and the fishing industry".

The five keynote presentations (see Supplementary S1 and S2) covered a wide range of topics by spanning from "classical" commercial fishing impact studies to the roles of women and men in the fishing industry and visualization of data through art:

- The evolution of bottom trawling impact on demersal fish populations and the benthic ecosystem (by Adriaan Rijnsdorp, Institute for Marine Resources and Ecosystem Studies, The Netherlands)
- To see the Sea: Using interactive installation art to visualize scientific data (by Caitilin de Berigny, University of Sydney, Australia)
- Fish is woman's business too—looking at marine resource use through a gender lens (by Kathleen Schwerdtner-Máñez, Leibniz Center for Tropical Marine Ecology, Germany)
- Historical evidence opens new swordfish recovery perspectives in the Northwest Atlantic (by Brian MacKenzie, Technical University of Denmark, Denmark)
- Historical ecology of sharks—reconstructing population changes, ecosystem consequences and societal value (by Heike Lotze, Dalhousie University, Canada)

How to combine scholarly insight with practical relevance was a much debated topic during the conference and researchers were encouraged to engage with marine managers and policy-makes at an early stage of their studies and to regularly brief them throughout. In this way, end-users could highlight issues of high relevance to them from the onset of research and help ensure that the research findings could be easily and quickly used in management initiatives and policy development. Other issues raised at the conference but not represented in the symposium papers include (i) the consequence of catastrophic events (natural disasters, wars) on marine exploitations, (ii) the cultural backgrounds and contexts associated with the historical development of both commercially and recreationally exploited species, and (iii) the historical development of the legal frameworks and regulations for fishery management. This cultural context has often been overlooked as most of the published studies on MHE and MEH has been from a distinctly western, and predominately European and North American, perspective. Encouragement of researchers from different cultural backgrounds to participate in the Oceans Past VI conference in Portugal in 2017 would help identify the role of this driver in the development of fisheries and fisheries regulations.

Discussion and conclusions

To make greater impact and ensure more efficient use of knowledge gained from MHE and MEH in ecosystem-based management and related policy context, the community of marine historical ecologists and marine environmental historians needs to work more routinely with population and ecological modellers and statisticians to further process the available data to derive ecologically meaningful properties such as distribution range, abundance, biomass, and consumption rates by predator populations. These data can then be used to assess the ecological impact of historical changes of affected species (e.g. Eddy *et al.*, 2014). At present many MHE and MEH teams lack these skills and/or are unaware of the data requirements used in modern stock and ecosystem assessment. As the available historical data often do not fit well to standard statistical or modelling procedures, especially those used in routine analytical fish stock assessments, methodologies applied to data-limited situations need to be considered, often with customized analysis solutions designed for each case (e.g. Rosenberg *et al.*, 2005; Lotze and McClenachan, 2013; Thurstan *et al.*, 2014; Fortibuoni *et al.*, 2016). There is also a gap in present knowledge regarding the timing of marine fish declines, especially in Europe, as a factor in driving human migration to North America in particular. There was general agreement among the conference participants that for MHE to be relevant to modern day fisheries or ecosystem management and policy development, there needs to be increased understanding of the relative importance of different demographic, technological, economic, and cultural drivers on the patterns, intensities and trajectories of human activities affecting the ocean. This will require development of broader multi- and trans-disciplinary research efforts that include historical demographers, sociologists interested in the development of human preferences for particular marine resources, economic historians, and researchers with an understanding of the importance of technology in driving the spread and power of marine living resource exploitations.

MHE and MEH need to improve the application of this knowledge to developing not only solutions for marine conservation, and recovery of collapsed populations and restoration of degraded habitats and ecosystems, but also offer know-how for applying adaptive and preventive measures to avoid population collapses and ecosystem degradations.

Supplementary data

Supplementary material is available at the *ICESJMS* online version of the manuscript.

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